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Experiences in Diphtheria Control in Northern British Columbia

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THE advent of war found the northwest area of the Province of British Columbia not prepared for unprecedented demands on existing public-health facilities. Since then, large-scale developments, including the expansion of the local shipyards and various other activities related to Canada's war effort, have taken place in the Prince Rupert district.

As a result of these new developments, the civilian population of Prince Rupert City was trebled and new problems arose. Supervision of water supplies, sewerage systems, milk production, restaurants, sanitation, food shortages, overcrowding and communicable-disease control, demanded the creation of a full-time public-health service. Accordingly, as a result of an agreement between the Department of Pensions and National Health, the British Columbia Board of Health, the City of Prince Rupert, and later the village of Terrace, the Prince Rupert and District Health Unit was established in June, 1942.

The area served by the Health Unit extends east 100 miles along the Canadian National Railway and Skeena River to Usk; north to the International Boundary; west to include the Queen Charlotte Islands; and south to Douglas Channel. In 1941, there was an estimated population of 18,000, or about 4.5 per cent of the total population of the province.

THE DIPHTHERIA PROBLEM

During the years 1939 and 1940 no cases of diphtheria were reported in the area. In 1941 there were 7 civilian cases (30 per cent of the provincial total of

An address to the Annual Institute for Public Health Workers, convened by the Provincial Board of Health in Victoria in April, 1944.

reported cases); in 1942, 47 civilian cases (78 per cent of the provincial total); and in 1943, 14 civilian cases (50 per cent of the provincial total). Of the 14 cases in 1943, 6 occurred in adults. Seven of the 14 occurred in November, 1943, in the Village of Terrace, with one death, an adult.

ANTI-DIPHTHERIA PROGRAM

The high incidence of this preventable disease was accepted as a challenge, and all members of the staff, past and present, have co-operated in an active anti-diphtheria campaign as part of the generalized public-health service of the Health Unit.

1. An intensive immunization program has been carried out in the widely scattered school population of approximately 1,800 throughout the area.

2. Since the population of the area is predominantly adult and since a high percentage of the cases of diphtheria in 1943 occurred in adults (with one death), Schick-test clinics for older age-groups were inaugurated.

4. A Schick-test survey and immunization campaign was carried out in the Prince Rupert Drydock, the largest single employer in the area.

5. The six salmon canneries to the south of Prince Rupert, at the mouth of the Skeena River, presented a special problem. The population is seasonal and almost entirely native Indian. The canning season lasts six weeks, during July and August. Three immunization trips of three days each were made. Transportation by boat was arranged through the Department of Indian Affairs.

6. In the outlying districts where medical services were available, immunization was stressed with the local physician or part-time medical health officer. Special programs were planned in co-operation with the Health Unit staff. A special approach was made to the practising physicians of the area. Each was written a letter stressing the immunization program and asking support in his family practice. An attempt has been made to have physicians complete the immunization record card (Figure I). These cards are returned to the Health Department office for filing. By this method the immunization status of the community will be readily available.

7. Since diphtheria is no respecter of civilian or military status, the hygiene officers of the various services worked in close co-operation with the Health Unit.

PUBLICITY

A slogan for all publicity was adopted: "Diphtheria is expensive, preventable and inexcusable". Full use of the three newspapers in the area was made, in paid advertisements announcing clinic dates and places, the local high incidence of diphtheria, and the means of prevention. News items and editorials were prepared. The press was most co-operative.

Special adult groups were approached regarding Schick testing. These groups included restaurant owners, retail-store employees, post-office staff and women's organizations. The Ministerial Association contributed pulpit announcements. Posters were prepared and exhibited by retail merchants. Free radio

PRINCE RUPERT HEALTH UNIT. Immunization and Comm. Dis. Record.						Family No. _____	
Name _____			Birth date (Mo.) (Day.) (Yr.) _____		Age _____	Sex _____	Race _____
Address 1 _____		School or Occupation _____				Phone 1 _____	
2 _____		3 _____				2 _____	
DIPHTHERIA. Date of Experience				PERTUSSIS. Date of Experience			
Date	Dosage	Reaction	Physician	Date	Dosage	Reaction	Physician
1 _____	_____	_____	_____	_____	_____	_____	_____
2 _____	_____	_____	_____	_____	_____	_____	_____
3 _____	_____	_____	_____	_____	_____	_____	_____
4 _____	_____	_____	_____	_____	_____	_____	_____
SCHICK TEST		Date	Reaction	Control		Physician	
1 _____		_____	_____	_____		_____	
2 _____		_____	_____	_____		_____	
SMALLPOX. Date of Experience							
Date	Reaction		Physician				
1 _____	_____		_____		_____		
2 _____	_____		_____		_____		
Code: ml=Mod. Local; sl=Severe Local; g=General.							
SCARLET FEVER. Date of Experience				T.A.B.T. Date of Experience			
Date	Dosage	Reaction	Physician	Date	Dosage	Reaction	Physician
1 _____	_____	_____	_____	_____	_____	_____	_____
2 _____	_____	_____	_____	_____	_____	_____	_____
3 _____	_____	_____	_____	_____	_____	_____	_____
4 _____	_____	_____	_____	_____	_____	_____	_____
5 _____	_____	_____	_____	_____	_____	_____	_____
6 _____	_____	_____	_____	_____	_____	_____	_____
DICK TEST		Date	Reaction		Physician		
1 _____		_____	_____		_____		_____
2 _____		_____	_____		_____		_____
OTHERS		Date	Reaction	Control	Physician		
KAHN _____		_____	_____	_____	VD No. _____		
Tbc. _____		_____	_____	_____	_____		
_____		_____	_____	_____	_____		
REMARKS _____							

AM-743-5510

Figure 1. COMMUNICABLE DISEASE AND IMMUNIZATION RECORD.

Above: face.

Below: reverse.

"spot" announcements over station CFPR were given at regular intervals throughout the fall and winter of 1943. Over 1,000 mimeographed letters were distributed to householders. The public-health nurses and the sanitary inspector made valuable home contacts in their routine visiting. Whenever the opportunity presented itself, short addresses were given to service clubs, women's organizations and others, by members of the staff.

At the Prince Rupert Drydock and Shipyard the co-operation of the management and the Allied Trades and Labor Council was obtained in sponsoring an

immunization program. The Yard arranged publicity and times and places of clinics at the plant.

In the schools the staff of the Health Unit met the elementary- and high-school principals and teachers in small groups and outlined the need for immunization. The teachers for the most part co-operated by giving lessons on the serious nature of diphtheria and the method for its control.

In November the City of Prince Rupert participated in "National Immunization Week" as sponsored by the Health League of Canada. This special program was initiated by a five-minute radio broadcast by His Worship the Mayor of Prince Rupert. New publicity was sent out in the way of posters, newspaper articles and editorials.

RESULTS OF THE PROGRAM

There has been a marked decrease in the number of cases of diphtheria in the area during the past year, and no cases in the past five months. In Prince Rupert 77 per cent, and in Terrace 86 per cent of elementary- and high-school children have been immunized. An estimate of the preschool population has not been made but there was an average weekly attendance of 60 infants and preschool children at clinics during the fall and winter of 1943. Approximately 800 adults have been immunized. The results of Schick-test surveys are interesting, in that positives ranged from 32 to 60 per cent.

Table I
SCHICK TESTS, PRINCE RUPERT AND DISTRICT, 1943

Group	Schick Pos. Control Neg.	Schick Neg. Control Neg.	Schick Neg. Control Pos.	Double Positive (Uninter- pretable)
650 adult males and females	60%			
519 adult males	40%	52%	5%	3%
396 adult males and females	32%	60%	6%	2%

DISCUSSION

1. Of the 14 cases of diphtheria in the Prince Rupert area in 1943, 6 (43 per cent) were in persons over 18 years of age. Although a small series, this shows the trend, as discussed by Fleming (1). Diphtheria is no longer primarily a children's disease. Our youngsters are being protected. Immunity in young adults who received toxoid during their school life is waning. Further, due to the relatively low morbidity of diphtheria in the past few years, we have a susceptible population in the young adult age-group which would, if diphtheria were endemic, be passively immune by reason of numerous contacts and sub-clinical infections.

2. The Schick-test survey figures given illustrate the upward trend of the percentage of Schick-test positives in adults. A similar experience in Halifax was reported by Campbell (2) and in Toronto by Wishart (3).

3. Considerable interest was shown at first by the adult public in the Schick-test program of the Health Unit. However, due to a decrease in the number of cases and to indifference, attendance at adult clinics dwindled in spite of the constant educational program.

4. The Terrace epidemic in November, 1943, was a sudden but localized outbreak. It was quickly brought under control due to the fact that 86 per cent of the school children in that village had been immunized, and to the prompt administration of prophylactic doses of 1,000 units of antitoxin to contacts, about 50 in number, who were also quarantined. There being no civilian hospital, an emergency centre was set up at the nearby camp through the courtesy of the Canadian Army, for isolation and treatment of cases. The village was placed out of bounds to Army personnel. No cases occurred in the camp.

There were no cases in persons previously toxoided. This fact considerably furthered the prestige of the newly organized public-health service.

An immunization clinic for adults was organized at the outset. A Schick test "control" only was given, and if negative in 24 hours, an initial dose of $\frac{1}{2}$ cc. of toxoid was given. Ninety-eight per cent of 350 persons tested were negative. This short-cut was adopted in part to obviate a five-day delay in reading a Schick test, and in part to satisfy the insistence on the part of this rural community, verging on panic, "to do something". Diphtheria had been unknown in this part of the district for thirty years, and the effect of the tragic death of a young mother from diphtheria can be appreciated.

The source of infection was traced to a young woman from Alberta who had apparently suffered an attack of diphtheria a year previously and had gone undiagnosed. Throat cultures were negative. Nasal cultures were positive and virulent. Her carrier state was cleared up in one week by the use of sulphathiazole powder 30 per cent in magnesium carbonate as a snuff as follows: 1st day q.2.h., 2nd day q.3.h., 3rd day q.4.h., and the 4th day q.4.h.

SUMMARY

1. An account of diphtheria experience in the northern coast district of British Columbia is presented.
2. Diphtheria was unknown in the area in the years immediately preceding the war.
3. In 1942, a total of 47 cases or 78 per cent of the total reported provincial incidence occurred in the area.
4. In 1943, 43 per cent of a total of 14 cases occurred in adults.
5. No cases occurred in immunized individuals.
6. Sulphathiazole powder 30 per cent in magnesium carbonate was effective in treating a virulent carrier state of probably one year's duration.
7. An account is given of a diphtheria control program.
8. Schick-test positives in three separate survey groups were 60 per cent, 40 per cent, and 32 per cent respectively.
9. Diphtheria is no longer largely a children's disease.
10. An adult Schick test and immunization program should be a part of every public-health service.

REFERENCES

- (1) Fleming, Donald S.: Diphtheria, a Problem of the Future. *Canad. M.A.J.*, 1944, 50:466.
- (2) Campbell, P. S.: The Occurrence of Diphtheria in Halifax from October 1, 1940, to January 31, 1941. *Canad. Pub. Health J.*, 1941, 32:404.
- (3) Wishart, F. O.: Intradermal Immunization with Diphtheria Toxoid. *Canad. J. Pub. Health*, 1943, 34:509.

A Streptococcal Epidemic in a Children's Surgical Ward

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THE epidemic spread of haemolytic streptococcal infections has been studied by a number of workers in recent years. Coburn and Pauli (1) described an epidemic of upper respiratory infections in a children's ward with type 12 haemolytic streptococci, involving 38 persons. A scarlet fever epidemic in an obstetric ward has been described by Diddle, Trussell and Plass (2) in which type 4 was responsible. Cruickshank (3) reported the results of frequent cultures of burns, and also examined the air and dust of the burns ward. Many haemolytic streptococci were recovered from the air, on exposed plates. There was a 2 per cent incidence of scarlet fever in the burns ward, while in the rest of the hospital the incidence was negligible. From swabs taken from the burned area late in the disease, streptococci could almost always be seen in the direct smear. On admission 6.5 per cent of the patients showed the presence of haemolytic streptococci in throat cultures, but the incidence of positive throat cultures rose to 25.6 per cent by the end of the first week in hospital.

Brown and Allison (4) published the results of an extensive investigation of streptococci in scarlet fever patients. They found that on discharge from the hospital 57 per cent carried a type of haemolytic streptococci different from that present on admission, and concluded that relapses and complications in scarlet fever are frequently due to reinfection with a different type. A type 22 outbreak of puerperal sepsis has been described by Bryce (5).

Studies similar to these have been described by Garrod (6), Wright (7), Cruickshank and Godber (8), Keogh et al (9), Keevil and Camps (10), Okell and Elliot (11), Bradley (12), De Waal (13, 14), and others (15, 16).

Present Investigation

An epidemic of streptococcal infections in a surgical ward of a children's hospital provided the material for this study.

Methods

1. *Isolation of haemolytic streptococci.* The usual sterile cotton swabs on wooden applicators were rubbed over the tonsillar areas and the back of the throat to obtain the material for culture. All swabs were planted as soon as possible on gentian-violet blood-agar plates (Garrod, 17; Francis, 18) to facilitate the isolation of haemolytic streptococci. Suspicious colonies were picked to blood-agar plates for isolation, and were preserved on blood-agar slopes until they could be grouped (Lancefield, 19) and typed (Griffith, 20).

From the Wards and Laboratories of the Hospital for Sick Children, Toronto, and the Department of Paediatrics, University of Toronto, under the direction of Alan Brown, M.D., F.R.C.P. (Lond.).

Unless colonies were seen which varied in size or appearance, only one colony was selected from each plate for typing. Early in the investigation several colonies were selected from each plate, but more than one type was never isolated from a single plate.

2. *Preparation of rabbit sera.* The grouping and typing sera which were used had been prepared by the method of Mueller and Klise (21). The undiluted sera were absorbed with formalin-killed streptococci of the heterologous types as advised by Griffith (20). For the last few sera prepared, a non-specific type 3 strain was used to remove the heterologous agglutinins with considerable, but not complete success (Griffith, 20; Neisser, 22). A combination of the two methods proved satisfactory. Sera giving rapid, floccular agglutination in 1/10 dilution with their type-specific antigens were obtained.

A number of crude sera proved satisfactory for ascertaining the Lancefield group.

3. *Grouping.* The antigens for the precipitin (Lancefield) test were prepared by the method of Fuller (23) and the test was carried out in the manner suggested by Brown (24). The microscope was seldom used to read the results of the precipitin tests because as a rule an unmistakable floccular precipitate appeared almost immediately in the positive tests. No strain was discarded until it had given two negative tests with Group A serum with two extracts prepared at different times from the strain in question.

4. *Suspensions for agglutination.* To obtain suspensions for agglutination (Neisser, 22), the cultures were grown in 1 per cent rabbit-serum beef-infusion broth overnight at 37°C. About 0.5 cc. from the top of this culture was put into Hartley Douglas tryptic digest broth. This was incubated and when growth was visible (in approximately four hours) a second tube of the same broth was inoculated in the same way. This was repeated once more during the day and left at room temperature overnight. Frequent subculturing into tryptic digest broth was repeated until the broth showed an even turbidity. This sometimes took ten to fourteen days. With persistently granular strains, occasional transfers into rabbit-serum broth aided in obtaining a satisfactory turbidity. The culture was then spun for about two minutes in the centrifuge to remove any clumps of organisms clinging to the side of the tube or floating in the broth. In this way cultures were found to be usable which would otherwise have been considered too granular. The supernatant fluid was removed by capillary pipette to a sterile plugged agglutination tube, centrifuged, the supernatant poured off and the sediment used in the slide agglutination-tests. All cultures were left overnight in the refrigerator before typing. A few cultures which appeared inagglutinable when first tested were returned to the refrigerator and tested again each day until the culture was agglutinable and the type was ascertained. All the cultures in this series were typed.

Description of the Ward. This ward admitted surgical cases from 2 to 5 years of age. It consisted of two rooms. The smaller, 13' x 20', was usually reserved for the more serious and post-operative cases. The larger room was

23' x 51'. The dressers' room and ward laboratory opened off this ward, as well as a large heated sunroom which was used for patients when the ward was crowded, and a small sunroom which was used for very serious cases or temporary isolation. The doors were always open.

The ward was definitely overcrowded at the time of this epidemic. In most cases the beds were separated only by a small table 20 inches wide, and the children could exchange toys with ease. A few patients, who were dressed, played and ate their meals at a table in the centre of the ward. Most of these children wore leg braces or casts and, although they played together, they could not move around the ward. One of these children became a symptom-free carrier. All the cultures which showed type 3 haemolytic streptococci (the epidemic type) were obtained from children in the large ward.

Investigation

During the week of October 21st-28th, four cases of streptococcal infection were transferred to the infectious ward from this ward. The first case of scarlet fever was diagnosed in S.L. on October 21st, 14 days after admission to hospital. R.D. developed scarlet fever on October 25th, 5 days after admission to hospital and 4 days after the first case had left the ward. The third case of scarlet fever, R.McM., appeared on October 26th, after 3 weeks in hospital. Two days later, October 28th, L.H., who had been admitted on October 14th with a severe wringer injury of the arm, developed erysipelas involving almost the entire wounded arm.

On October 29th, a detailed investigation of the outbreak was begun. Cultures were made at once from the throats of the four children who had been transferred to the infectious ward and from the wound of the erysipelas patient. These cultures all showed the presence of type 3 haemolytic streptococci. Cultures were also obtained on October 29th or 30th from the 32 patients on the surgical ward and from 15 of the ward personnel. Of these, 5 children and 1 nurse were found to be carrying haemolytic streptococci. The children were transferred to the Infectious Ward, and the nurse, who had had a severe cold with sore throat for over a week, was sent off duty. Type 2 haemolytic streptococci were isolated from the throat of one of the children. The cultures from the other four children and from the nurse proved to be type 3, the epidemic type. These patients all showed temperatures over 100°F. for several days but had no other clinical symptoms.

On November 1st, A.G., a child who had had a negative throat culture on October 29th, developed scarlet fever. This little girl of five was very co-operative, and, as excellent cultures showing many type 3 haemolytic streptococci were obtained on all later occasions, it was felt that she had become infected since the previous swab was taken three days before. A summary of these cultures is given in Table I.

Throat cultures were taken from all patients (28) and personnel (24) on November 6th to 8th. Cultures positive for haemolytic streptococci were obtained from 7 children, 2 nurses and 1 orderly. Three of these patients had previously

had negative throat swabs; two now carried type 3, one running a temperature over 100°F. for 5 days and the other showing no symptoms. The other strain proved to be type 12. Four of the children with positive cultures had not been swabbed previously. Two of these were found to carry type 3. They remained symptom-free. The other two carried type 2. Many colonies of type 3 haemolytic streptococci were isolated from the throats of the two nurses who were sent off duty. They both developed severe colds. The orderly who carried type 3 showed no symptoms. He also was moved from this ward.

TABLE I
SUMMARY OF POSITIVE THROAT CULTURES OCTOBER 29TH-NOVEMBER 3RD

Streptococci Type	Patient or Personnel	Date of symptom or culture	Length of time on ward	Symptoms	Disposal
3	Patient S.L.	Oct. 21st	14 days	Scarlet fever	To Infec. Ward Oct. 21st
3	Patient R.D.	Oct. 25th	5 days	Scarlet fever	To Infec. Ward Oct. 25th
3	Patient R.McM.	Oct. 26th	21 days	Scarlet fever	To Infec. Ward Oct. 26th
3	Patient L.H.	Oct. 28th	14 days	Erysipelas	To Infec. Ward Oct. 28th
2	Patient	Oct. 29th	2 mos.	Temp. of 100°F. for 2 days	To Infec. Ward Nov. 1st
3	Patient	Oct. 29th	38 days	Temp. over 100°F. for 5 days, reaching 101°F.	To Infec. Ward Nov. 1st
3	Patient	Oct. 29th	9 days	Temp. over 100°F. for 5 days, reaching 101°F.	To Infec. Ward Nov. 1st
3	Patient	Oct. 29th	10 days	Temp. over 100°F. for 3 days, reaching 103°F.	To Infec. Ward Nov. 1st
3	Patient	Oct. 29th	55 days	Temp. over 100°F. for 7 days, reaching 103.8°F.	Discharged Nov. 1st
3	Nurse Miss G.C.	Oct. 29th	12 days	Cold, sore throat, fever	Off duty Oct. 30th
3	Patient A.G.	Nov. 3rd	12 days	Scarlet fever	To Infec. Ward Nov. 3rd

A summary of these positive throat cultures is shown in Table II.

As the removal of the patients carrying haemolytic streptococci in their throats had not controlled the epidemic, further measures to check the spread were put into force on November 8th, as follows:

1. The ward was closed to admissions and visitors.
2. Throat cultures were taken on each person at least every other day—every day if any symptoms developed.
3. All children were kept in bed.

4. A separate gown was used in attending each patient.
5. All personnel wore flannelette masks.
6. Basins and water for washing were provided in the ward—at least one basin to every other patient. (Prior to this, only one washroom was available.)
7. All personnel were instructed to wash and apply Dettol Obstetric cream to the hands before and after attending each patient.

TABLE II

SUMMARY OF POSITIVE THROAT CULTURES NOVEMBER 5TH–NOVEMBER 8TH

Streptococci Type	Patient or Personnel	Date of positive culture	No. of previous neg. cultures	Length of time on this ward	Symptoms	Disposal
3	Nurse	Nov. 5th	0	At least 1 week	Cold, sore throat fever	Off duty Nov. 6th
3	Patient	Nov. 6th	1	31 days	Temp. over 100°F. for 5 days, reaching 103°F.	To Infec. Ward Nov. 8th
3	Patient	Nov. 6th	1	10 days	None	Home Nov. 7th
12	Patient	Nov. 6th	1	13 days	Fever to 100°F. for 3 days	To Infec. Ward Nov. 8th
3	Patient	Nov. 6th	0	15 days	None	Home Nov. 7th
3	Patient	Nov. 6th	0	7 days	None	To Infec. Ward Nov. 8th
2	Patient	Nov. 6th	0	Months	Had had a cold with haemolytic streptococci in throat 2 wks. earlier	To Infec. Ward Nov. 8th
2	Patient	Nov. 6th	0	1 day	Nasopharyngitis, cervical adenitis, red throat. Temp. over 100°F. for 10 days, reaching 102°F.	To Infec. Ward Nov. 10th
3	Nurse	Nov. 7th	1	At least 1 week	Cold, sore throat, fever	Off duty Nov. 8th
3	Orderly	Nov. 8th	0	1 day	None	Off this ward Nov. 9th

8. The beds were spaced 9 feet apart, with an empty bed between each occupied bed. (This was possible as the ward population had fallen from 32 to 20.)
 9. The bed positions were not to be changed.
 10. The floors were washed twice daily with a wet mop instead of being dry-mopped, using carbolyzed sawdust (*So Clean*).
 11. All dressings were done on the ward instead of in the dressers' room.
- These measures proved effective in preventing any further spread of the epidemic among the children, for no throat cultures positive for haemolytic

streptococci type 3 were obtained from any of the patients after November 6th. Cultures from 4 patients showed haemolytic streptococci between November 10th and November 14th but none of them proved to be type 3. The types found were type 12, type 11, type 5 and type 25. Type 3 was obtained from two of the personnel after the special precautions were put into effect, as follows. On November 11th a positive culture was obtained from the throat of a ward aid, and on November 13th from a nurse who developed a sore throat and cold. These two had been on the ward since the beginning of the epidemic, but their previous cultures had been negative. It is interesting to note that these two individuals did not infect any of the patients. This may have been due to the preventive measures put into force on November 8th. The culture from a second ward aid showed type 5 haemolytic streptococci on November 19th.

TABLE III
SUMMARY OF POSITIVE THROAT CULTURES NOVEMBER 10TH-19TH

Strepto- cocci Type	Patient or Personnel	Date of positive culture	No. of previous neg. cultures	Length of time on this ward	Symptoms	Disposal
25	Patient	Nov. 10	1	6 days	None	To Infect. Ward Nov. 11th
3	Ward Aid	Nov. 11	1	3 years	None	Off duty Nov. 12th
3	Nurse	Nov. 13	2	Before Oct. 29th	Cold, sore throat	Off duty Nov. 14th
12	Patient	Nov. 13	3	11 days	Slight cold, temperature	To Infect. Ward Nov. 14th
11	Patient	Nov. 14	3	14 days	Temp. over 100°F. for 6 days, reaching 100.6° F.	To Infect. Ward Nov. 18th
5	Patient	Nov. 19	4	16 days	No symptoms	To Infect. Ward Nov. 20th
5	Ward Aid	Nov. 19	9	3 years	No symptoms	Off duty Nov. 20th

A summary of these cultures is shown in Table III.

In all, 405 throat cultures were made on 95 individuals—51 children and 44 adults. Group A haemolytic streptococci were recovered on 31 occasions; 19 (60 per cent) of these were type 3, and 12 were other types, as shown in Table IV.

Wound Cultures. Cultures were taken from all open wounds on this ward. Of 23 cultures made from 8 patients, only one colony of haemolytic streptococci (type 28) was recovered. This was from a seriously ill burn-case, and as the child was alone in the small sunroom no further isolation was enforced. In the cultures taken subsequently from this patient no streptococci were found. These figures do not include the cultures from the patient with erysipelas who had been moved to the Infectious Ward on October 29th.

Contamination of the Air. Gentian-violet blood-agar plates were exposed to the air and a few samples of air were taken with the Wells Air Centrifuge, with the following results.

Exposed plates. Plates were exposed to the air of the ward on 6 days between October 29th and November 14th. The plates were usually placed on a chair, occasionally on a table or the floor. They were placed beyond the reach of the children. As shown in Table V, type 3 haemolytic streptococci were recovered from the air until November 11th. All these colonies isolated from the air were typed and all proved to be type 3.

TABLE IV
SUMMARY OF THROAT CULTURES

	Personnel	Patients
Number cultured	44	51
Number with Type 3	6	13
% infected with Type 3	13.6%	25.5%
Number with other types	4	8
% infected with other types	9.1%	19.6%
Total % infected with streptococcus	22.7%	45.1%

TABLE V
HAEMOLYTIC STREPTOCOCCI RECOVERED FROM PLATES
EXPOSED TO WARD AIR

Date	No. of plates exposed	Length of time	No. of colonies of haem. strept. type 3 recovered
Oct. 29	4	1½ hours	3
Oct. 31	4	1 hour	2
Nov. 5	2	1½ hours	5
Nov. 11	3	2 hours	2
Nov. 13	2	1½ hours	0
Nov. 14	2	2½ hours	0

As gentian-violet (which inhibits the growth of staphylococci, aerobic spore-bearing bacilli and diphtheroids) was used in the plates, no information was obtained on the total number of bacteria falling on the plates.

Wells Air Centrifuge. Samples of air using a Wells Air Centrifuge were taken on October 30th from six positions in the two wards. Lactose broth with brom-thymol blue was used as suggested by Wells (25). Haemolytic streptococci were recovered from two samples of air. One of these was type 3 and the other was overgrown by a spreader and could not be isolated.

DISCUSSION

Source of the Infection. The original source of the type 3 haemolytic streptococci in this ward cannot be stated. But there is a reasonable possibility that the nurse, Miss G. C., may have introduced it into the ward. This nurse came on duty on October 17th with a cold, and symptoms of infection appeared in S.L., the first scarlet-fever case, two days later on October 19th—a not uncommon incubation period for streptococcal infection.

Mode of Spread. This outbreak of streptococcal infection which involved all parts of the ward suggests a source common to the whole ward. This may have been air, contaminated either directly by droplets and droplet nuclei from infected throats, or indirectly by streptococci projected into the air during bed-making, and by infected dust stirred up by sweeping (Hare, 26; Thomas and Van den Ende, 27; Brown and Allison, 4; White, 28; Cruickshank, 29; Glass, 30). The overcrowded condition of the ward may well have contributed to the spread of infection by allowing the direct projection of infected droplets from one child to another. Droplets from the noses and throats of infected nurses are another likely source of streptococci. During this investigation many haemolytic streptococci type 3 were recovered from the top sheet of the erysipelas patient by the simple expedient of rubbing a moist, sterile swab over a small area of the sheet, pulling off the cotton into broth, adding this to melted blood agar and pouring a plate. On other occasions we have noted the increase in the number of haemolytic streptococci obtained on exposed blood-agar plates during the period following sweeping and bed-making. We have also recovered haemolytic streptococci from the dust of occupied rooms in other investigations.

While no attempt was made to ascertain the means by which the streptococci reached the air, their presence was demonstrated by the recovering of type 3 organisms from the air during the time infected persons were in the ward. No haemolytic streptococci were recovered from the air after the removal of the last throat carrier from the ward. As shown by Hare (31), the hands of the carrier may harbour the organisms. In an attempt to prevent the hand-borne spread of infection, Dettol Obstetric Cream (which we had previously tested and found effective) was used by the staff before and after attending each patient. Cultures were taken from the hands of four nurses who were using this technique but no haemolytic streptococci were recovered.

Dick tests. It is interesting to note that the four children who developed scarlet fever showed negative Dick tests on admission to the hospital. Of the other 9 children involved in the epidemic, 7 had negative Dick tests (Peacock et al, 32; Fraser, 33).

SUMMARY

1. An epidemic due to type 3 haemolytic streptococci on a children's surgical ward is described.
2. The probable modes of spread of the infection are discussed. It is

believed that close contact of patients due to overcrowding of the ward, the presence of infected attendants, inadequate washing facilities, and the presence of haemolytic streptococci in the air are all important.

3. The epidemic was checked by: (a) the removal of all those with positive throat cultures; (b) the closing of the ward to admissions and visitors; (c) the use of flannelette masks and individual gowns; (d) the spacing of the beds 9 feet apart; (e) the provision of adequate washing facilities for the personnel; (f) the use of a reliable hand antiseptic (Dettol Obstetric Cream); and (g) the wet-mopping of the floor instead of sweeping.

4. A negative Dick test did not indicate immunity to scarlet fever caused by this strain of haemolytic streptococci.

5. The advantage of a more rapid method of typing haemolytic streptococci became very evident during the course of this investigation.

REFERENCES

- (1) Coburn, A. F., and Pauli, R. H.: *J. Exper. Med.*, 1941, 73: 551.
- (2) Diddle, A. W., Trussell, R. E., and Plass, E. D.: *Am. J. Obs. & Gynec.*, 1940, 39: 608.
- (3) Cruickshank, R.: *J. Path. & Bact.*, 1935, 61: 367.
- (4) Brown, W. A., and Allison, V. D.: *J. Hyg.*, 1937, 37: 1.
- (5) Bryce, L. M.: *Med. J. Australia*, 1939, 1: 900.
- (6) Garrod, L. P.: *Lancet*, 1936, 231: 944.
- (7) Wright, J.: *J. Hyg.*, 1940, 40: 647.
- (8) Cruickshank, R., and Godber, G. E.: *Lancet*, 1939, 236: 741.
- (9) Keogh, E. V., McDonald, I., Battle, J., Simmonds, R. T., and Williams, S.: *J. Hyg.*, 1939, 39: 664.
- (10) Keevil, N. L., and Camps, F. E.: *Lancet*, 1937, 233: 207.
- (11) Okell, C. C., and Elliot, S. D.: *Lancet*, 1936, 231: 836.
- (12) Bradley, W. H.: *Brit. M.J.*, 1938, 2: 733.
- (13) DeWaal, H. L.: *J. Hyg.*, 1940, 40: 172.
- (14) DeWaal, H. L.: *J. Hyg.*, 1941, 41: 65.
- (15) Keogh, E. V., and Kelsey, H.: *Med. J. Australia*, 1939, 1: 100.
- (16) Allison, V. D., and Brown, W. A.: *J. Hyg.*, 1937, 37: 153.
- (17) Garrod, L. P.: *Lancet*, 1933, 231: 944.
- (18) Francis, A. E.: *Lancet*, 1941, 241: 159.
- (19) Lancefield, R.: *J. Exp. Med.*, 1933, 57: 571.
- (20) Griffith, F.: *J. Hyg.*, 1934, 34: 542.
- (21) Mueller, J. H., and Klise, K. S.: *J. Immunol.*, 1932, 22: 53.
- (22) Neisser, H.: *J. Path. & Bact.*, 1939, 48: 1.
- (23) Fuller, A. T.: *Br. J. Exper. Path.*, 1938, 19: 130.
- (24) Brown, J. H.: *J.A.M.A.*, 1938, 111: 310.
- (25) Wells, W. F., Phelps, E. B., Robertson, E. C., and Winslow, C.-E. A.: *Year Book of the American Public Health Association, 1940-1941, Supplement to Am. J. Pub. Health*, 1941, 31: 129.
- (26) Hare, R.: *Canad. Pub. Health J.*, 1940, 31: 539.
- (27) Thomas, J. C., and Van den Ende, M.: *Brit. M.J.*, 1941, 2: 953.
- (28) White, E.: *Lancet*, 1936, 230: 941.
- (29) Cruickshank, R.: *Lancet*, 1941, 240: 493.
- (30) Glass, V.: *Lancet*, 1941, 240: 524.
- (31) Hare, R.: *Lancet*, 1940, 238: 109.
- (32) Peacock, S., Bigler, J. A., and Werner, M.: *Am. J. Dis. Child.*, 1939, 57: 759.
- (33) Fraser, F. H.: *Canad. Pub. Health J.*, 1937, 28: 53.

Trial of Dysentery Toxoid (Shiga) in Human Volunteers

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IN a previous report (Farrell and Ferguson, 1943), laboratory and clinical data were presented which suggested that the experimental product Dysentery Toxoid (Shiga), prepared and tested as described, was antigenic and safe for human use and would afford a reasonable hope of protection against dysentery caused by *Shigella dysenteriae* (Shiga). Experience in its use in human subjects was limited, however, so that no recommendation could be made with regard to dosage and the interval between injections, little evidence was available with regard to the duration of antitoxic immunity, and even the amount of reaction likely to occur in a large group of subjects could not be foreseen with any certainty. This last lack is of especial importance in view of the severe local reactions reported by Kesterman and Vogt (1941) with a formalinized toxin mixed with vaccine, and the type of reaction observed in several persons who took part in the experiments previously reported from these Laboratories. The present report describes the reactions in 142 persons who received 1 to 4 doses of the toxoid at various intervals, or a total of 377 injections, and sets forth the results of titration of antitoxin in 215 samples of blood taken from 100 persons at different stages in the process of immunization.

Injections

The 142 volunteers who took part in this study were drawn from the Canadian Army and from the class in second-year Pharmacy, University of Toronto.* Among the soldiers, 2 groups were set up, to receive 3 injections at intervals of 10 days and 40 days respectively. The 10-day group also received a recall dose 3 months after the third dose. Blood was drawn for titration of antitoxin 10 days after the second and third dose in both groups and at the time of, and 10 days after, the recall dose in the "10-day" group. The student group received 3 doses at intervals of 3 weeks and blood was drawn 10 days after the third dose.

In order to assess the amount of reaction caused by an injection of Shiga toxoid, an attempt was made to compare it directly with the amount caused by an injection of T.A.B.T., the combined antigen of tetanus toxoid and typhoid and paratyphoid vaccines used in the armed forces of Canada. This seemed a realistic comparison to make because the experience in the use of T.A.B.T. is wide and the reactions are definite. Hence every fifth man in the

*In the Army group, we wish to thank especially Major W. E. Gregson, District Hygiene Officer, M.D. 2, who was responsible for the complex arrangements; Captain K. McD. McIntosh, M.O. Army Trade School, Hamilton, who gave the injections and drew the samples of blood, and the 86 soldiers who volunteered to take part in the experiment. In the University group, we wish to thank Dr. F. O. Wishart for the large part he took throughout the trial, Dr. F. H. Fraser, Dr. H. J. Leeson and Miss G. L. Mickle for drawing blood, and the 56 student volunteers who took part.

Army groups (18 of 86) received half the usual dose (0.5 cc.) of T.A.B.T. instead of the first dose of dysentery toxoid. The doses of dysentery toxoid given to the Army groups were uniformly 0.25 cc., although it was originally planned to give 0.5 cc. at the third dose. In the student group of 56 persons the first dose was 0.5 cc., the second 0.25 cc. and the third 0.5 cc. The same lot of toxoid was used for all injections except the first dose in the student group. Supplementary laboratory data obtained on this lot of toxoid showed that 1 month after being diluted with glycerine solution and filled into ampoules it was more toxic for rabbits than the original material tested at the same time. No reason for this has been found in spite of diligent search but it was deemed advisable to discontinue its use. Subsequent injections were therefore given with the same lot of toxoid as was used for the Army groups.

Reactions

A report received from Major Gregson on the questioning of about half the Army group after the first injection of toxoid showed that all of these men had a sore arm and probably 75 per cent had headache. About 12 per cent reported chills and muscle soreness and 12 per cent urinary frequency. Only 13 per cent reported no systemic reaction. Nevertheless, the opinion was expressed that the reactions were considerably less than with T.A.B.T. because usually about 2-3 per cent of men are off duty for 24 hours after T.A.B.T. inoculation. In contrast, there were no men off duty after the Shiga toxoid injection. In these tests, therefore, it would appear that the reactions were quite definite but in no case severe and there was nothing to suggest that the toxoid should not be used generally.

In the student group also, all subjects had a sore arm after the first dose. In 36 of 55 questioned, this local reaction was slight or moderate; in 18 it was marked, lasting several days and causing considerable restriction of movement, and in some cases there was some recurrence of inflammation. One student had a severe reaction which recurred after 4-5 days and lasted for about 4 weeks, but finally subsided without breaking down of the tissues. The systemic reactions were perhaps more pronounced than were reported from the Army groups, although 27 per cent reported having none at all and 6 per cent only a slight or moderate reaction which lasted less than one day and was not incapacitating. Two subjects reported a marked reaction characterized by fever, headache and nausea lasting more than a day, and 2 subjects a severe reaction with headache, vomiting, and a temperature of over 100°F., and absence from work for a day or two. Whether these severe reactions were due to the larger dose or the particular lot of toxoid used, whether these individuals were especially susceptible or whether any group of 100-150 persons might be expected to include 1 or 2 who would have a severe reaction, is not clear. The reaction to further doses, including 0.5 cc. in the student group, was usually trivial although a few persons who had reported none to the first had a slight or moderate reaction to one of the later doses. Only one person had a moderate reaction after all 3 doses. Summarizing, it may be said that the degree of

reaction to injections of dysentery toxoid (Shiga) was of the same order as that to T.A.B.T. and possibly less marked.

Estimation of Antitoxin

The method of estimating the circulating antitoxin was modified from that outlined in the previous report. By trial a dose of toxin was found which, when combined for 45 minutes at 37°C. with 0.025, 0.050, and 0.075 standard units of antitoxin and injected intravenously in a total volume of 0.5 cc. into each of 6 mice (15-18 g.) in the respective groups, would allow the "50 per cent end point" to be calculated (Reed and Muench, 1938). This test dose, 0.0012-0.0015 cc., was combined with the unknown serum for injection in 0.5 cc. total volume into each of a group of at least 4 mice and the unitage of the serum calculated by comparison with the standard series of controls set up at the same time. As the amount of serum available was usually limited, it was customary to test each sample first at a level approximating 1 unit/cc., and then retest above or below this level, depending upon the results of the first test. In some instances, sufficient serum was available to test for as little as 0.05 s.u./cc., but frequently there was not enough to estimate less than 0.2 s.u./cc. For this reason, the "detectable" amount has been considered in this report to be 0.2 s.u./cc. So far as is known, this amount has no clinical or other significance but is based wholly upon the exigencies of the present study.

Response in Antitoxin

The results obtained on titration of the antitoxin in 215 samples of serum are shown in the table.

RESPONSE IN ANTITOXIN OF GROUPS OF HUMAN SUBJECTS INJECTED WITH
DYSENTERY TOXOID (SHIGA)

Interval between injection	Dosage	No. of samples tested	Per cent 0.2 s.u./cc. or more	Per cent 1 s.u./cc. or more	Per cent 5 s.u./cc. or more
10-day Army group	2 doses of 0.25 cc.	38	76.3	36.8	27.6
	3 doses of 0.25 cc.	33	87.9	60.6	33.3
	3 months after 3rd.	27	59.2	48.1	11.1
	Recall dose (0.25 cc.) . . .	26	88.5	84.6	39.1
21-day Student group	3 doses 0.5, 0.25, 0.5 cc. .	32	93.8	87.5	28.1
40-day Army group	2 doses of 0.25 cc.	29	72.4	44.8	3.4
	3 doses of 0.25 cc.	30	93.3	90	30

As the table shows, of 38 persons who received 2 doses 10 days apart, more than 76 per cent had detectable antitoxin 10 days later, while a third dose to 33 of these persons increased this percentage to nearly 88. Not only did a larger percentage have detectable antitoxin but, as might be expected, the

titres were on the whole much higher. As work on recovered patients had indicated (Farrell and Ferguson, 1943), the level of antitoxin was reasonably well maintained, nearly 60 per cent still having detectable antitoxin after 3 months and 48 per cent having 1 s.u./cc. or more. A recall dose given after this interval of 3 months caused a detectable response in over 88 per cent of the volunteers, most of them developing 1 s.u./cc. or more and 39 per cent developing at least 5 s.u./cc. However, only 1 of 4 persons who had failed to respond to the initial series of 3 doses gave a detectable response to the recall dose.

In the group which received 3 doses at intervals of 3 weeks, the general response was better, over 93 per cent having detectable antitoxin 10 days later and 87.5 per cent having 1 s.u./cc. or more. The advantage appeared to be with the longer interval, although dosage may also have been a factor. In this group, 2 persons failed to develop antitoxin within the limits of the test.

When 2 doses were given with an interval of 40 days, the response was definitely poorer than with 3 doses over a period of 30 or 40 days, while a third dose after a further interval of 40 days gave a response in over 93 per cent of the group and all but 1 of these had 1 s.u./cc. or more. In this group also 2 persons failed to develop detectable antitoxin.

From these tests, it is evident that at least 3 doses of this antigen should be administered to obtain a good response in a reasonable percentage of individuals. As would be anticipated, increasing the interval between doses somewhat increased the percentage of persons giving a detectable response but the difference was not striking. In all groups, a few persons failed to develop antitoxin to the level detectable in this study.

DISCUSSION

The question of whether Dysentery Toxoid (Shiga) will confer protection against dysentery due to the Shiga bacillus under conditions of exposure likely to occur amongst persons living in areas where this disease is endemic can only be answered conclusively by carrying out a properly controlled field trial or by experimentally infecting suitably selected human volunteers both immunized and unimmunized. The hazards of the latter experiment would not seem too great in view of the alleged usefulness of chemotherapy and the availability of potent antiserum, although either of these methods of obtaining convincing evidence appears to be beyond the scope of a laboratory. Nevertheless, as present circumstances suggest that a field trial is desirable, it seemed essential to obtain further data with regard to the best mode of administration and the reactions and antitoxic response to be anticipated in a large group of human subjects.

The difficulties of obtaining clear-cut answers to these problems are well known. Large groups of persons are not always available and co-operation must be on a voluntary basis after proper explanation of the purpose and possible hazards of the experiment. The chief difficulty lies in the fact that it is the privilege of volunteers to fail to appear for an injection or the withdrawal of blood at the proper time. With the best of will to co-operate, un-

avoidable causes interfere with the program, especially in the Army where unexpected transfers of personnel are made or where leave may be given. In this work, consequently, about 25 per cent of the original volunteers were not available throughout the required periods and had to be left out of the final analysis. Nevertheless, this loss was fairly evenly distributed so that the groups were reasonably comparable and large enough to give some picture of what might be anticipated in a field-trial.

Another difficulty in this study was that it was not possible for us to question each of the volunteers about the amount and type of reaction produced. It is therefore impossible to say whether the appraisal of reactions in the Army groups, where the men were questioned by the Medical Officer, is strictly comparable with that made by us, ourselves, in the student group. The conclusion appears warranted, however, that no reactions in the Army group were more severe than those we observed among the students and probably were less significant, either because a smaller initial dose was given or because the lot of toxoid used was entirely innocuous to laboratory animals. This latter explanation would seem more reasonable and serves to emphasize the necessity, referred to in the first report, of repeated testing in laboratory animals of material intended for human use. Provided due caution is observed in this respect, however, it seems justifiable to assume that a field-trial of this material could be undertaken without undue concern about possible reactions.

The results presented in this report do not admit of unqualified recommendations with regard to dosage and the interval between injections. It seems clear that not fewer than 3 spaced doses should be given and intervals of 10 days are not likely to give as good results as longer intervals. In all groups, some persons failed to respond to the arbitrary level of 0.2 s.u./cc. and the recall dose was especially disappointing in this respect. Where time is not a factor the long intervals of 40 days would seem better, but likely would prove impracticable and the difference is probably insignificant except with regard to actual level of antitoxin.

The relation of titre of antitoxin to clinical immunity is not known, although usually recovery from the disease appears to be associated with the development of antitoxin (Welcker, 1938; Farrell and Ferguson, 1943). Further evidence on this point has been obtained through the continued courtesy of Dr. R. E. Wheeler, who sent us samples of serum taken 3 weeks after onset of illness in 16 patients from the epidemic of Shiga dysentery in Kentucky in 1941. Of these, 4 were bacteriologically diagnosed cases and 12, suspected cases. The 4 proved cases had antitoxin titres of 0.8 s.u./cc., 5 s.u./cc., $>5 < 10$ s.u./cc. and $>10 < 15$ s.u./cc. respectively. In 6 suspected cases, antitoxin was found at levels ranging from 0.2 s.u./cc. to >60 s.u./cc. In 5 suspected cases, insufficient serum was available to test at titres below 0.5-1 s.u./cc. and no conclusions about the presence of antitoxin can be drawn. In the remaining case, no antitoxin was found at a level of 0.05 s.u./cc. which is close to the lower limit of this test. Similar results were found in 1 of the 6 recovered patients previously studied. As this patient alone made no detectable response to a dose of toxoid, it was considered doubtful whether he had actually had Shiga dysentery. Nevertheless, both these persons may have

had Shiga infection and clinical recovery may be possible without the appearance of detectable antitoxin. However, of 21 known or suspected cases in the 2 studies, antitoxin was detected in 15, and in only 2 of the remaining 6 was the level of test low enough to suggest that antitoxin was not present. Neither of these 2 cases was bacteriologically confirmed.

Logically, therefore, one might aim at the development of antitoxin to a titre corresponding at least to the lowest level detected in a recovered patient (0.2 s.u./cc.). In this study, the difference in response to toxoid in the 3 groups was not great enough to be unequivocal. We would be inclined to suggest that intervals of 3 weeks be used for practical purposes, and that a recall dose be given in 3 months. This recommendation would be in line with the experimental work and with the experience of other antigens such as diphtheria and tetanus toxoid. Also by analogy with other antigens, it would seem reasonable to maintain antitoxic immunity with subsequent recall doses annually as circumstances dictate.

SUMMARY

1. Dysentery Toxoid (Shiga), prepared and tested as described in a previous report, was given to 142 human volunteers in 1 to 4 doses of 0.25 cc. or 0.5 cc., or a total of 377 injections. Three groups of persons received 3 injections at intervals of 10, 21 and 40 days respectively and the 10-day group received a recall dose 3 months after the third dose. Circulating antitoxin was titrated in 215 samples of blood taken from 100 persons at different stages in the process of immunization.

2. The reactions to the injections, both local and systemic, were of the same order as those to the combined antigen T.A.B.T. Provided due caution be observed in the proper testing of the toxoid in laboratory animals, it would appear that a field-trial of this material could be undertaken without undue concern.

3. The antitoxic response was strikingly better after 3 doses than after 2. Long intervals between doses were advantageous, but the differences were not marked.

4. Results are presented of titration of serum drawn 3 weeks after onset of illness from persons, both known and suspected cases, connected with an outbreak of Shiga dysentery.

5. The results obtained are discussed particularly in regard to the relation between antitoxic immunity and clinical immunity to Shiga dysentery. Recommendations are made for a course of injections for possible use of this material in a field-trial.

We wish to express our thanks to Dr. Ralph E. Wheeler, Tufts College Medical School, Boston, Mass., for sending samples of convalescent serum for titration, and to the National Research Council for a grant in aid of this project.

REFERENCES

1. Farrell, L. and Ferguson, H.: *Canad. J. Pub. Health*, 1943, 34: 130.
2. Kesterman, E., and Vogt, K. E.: *Klin. Wchnschr.*, 1941, 20: 739 (*Abstr. Bull. War Med.*, 1942, 2: 401).
3. Reed, L. J., and Muench, H.: *Am. J. Hyg.*, 1938, 27: 473.
4. Welcker, A.: *Ztschr. f. Immunitätsforsch. u. exper. Therap.*, 1938, 93: 346.

The Health Officer and Cyanide Fumigation

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IN fumigation, the health officer is concerned with two things: the protection of the public, and the efficiency of the destruction of pests which not only make life miserable for people but which may also spread disease.

Although fumigations with cyanide compounds have been used rather extensively for several years, even yet many municipalities have trouble with these fumigations; and in some places chances are continually being taken which endanger the lives of the citizens.

In spite of every precaution, the use of any poisonous material will endanger lives; and occasionally there will be fatalities because of the human element, which unfortunately has to be taken into account in health work. Usually someone who knows better becomes just a little careless, makes a mistake, forgets, or allows something which ordinarily should not have been done. The result is that all who have anything to do with the fumigation come in for censure. The reporting in the press of one fatality makes it not only disagreeable for the operator and the health department of the municipality, but fumigators in other places may have difficulty in assuring their clients that needed fumigation of premises can be safely done.

In order to reduce the risk of trouble, everyone responsible must carry out regulations to the letter, and no chances whatsoever should be taken in this work. The purpose of this paper is to review what can be done to make cyanide fumigations safe for the operator and for the public. There will perhaps be nothing new, but emphasis will be placed on certain aspects of fumigation which are apt to be taken for granted.

In every fumigation where cyanide is used, it would appear that there are six interested parties—the Provincial Department of Health, the municipality, the medical officer of health (or someone appointed by him), the operator, the occupants of the premises to be fumigated, and the general public. Some must assume a certain amount of responsibility, while certain others must be protected against danger.

PROVINCIAL RESPONSIBILITY

Most provinces in Canada have a satisfactory Act covering fumigations with cyanide compounds. That for Ontario is an amendment to the Public Health Act. Fumigation and fumigator are defined, licensing and bonding are outlined, and it is determined who may do fumigations and be responsible for the notices prior to fumigation. Perhaps this Act for fumigation does not go as far as it should. It might be more satisfactory if every fumigator had to be

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qualified by a written examination as well as the oral one now used. In some of the United States this is now compulsory. Certainly it is very wise that the Province should license fumigators, and insist that they be in good health, be physically fit, and that they know the danger to themselves and to others when hydrocyanic acid or cyanide compounds are used.

Regulations for the use of these compounds for fumigation are detailed by an Order-in-Council which covers very completely the way in which fumigations may be done. They provide for the control of the hazards associated with the use of cyanide compounds in fumigation, and stipulate that these substances shall be used for this purpose only by those licensed by the Department of Health upon the recommendation of the local medical officer of health. The procedure of fumigation, as well as the preparation of the premises and the airing-out afterwards, is completely covered in order to make the premises safe for occupancy. Premises are defined and, because they are mainly households, cyanide may be used only with the simultaneous use of warning gas. The substances used must be approved by the Department.

THE MUNICIPALITY

The municipality must assume its share in regard to every fumigation. Some municipalities have passed local by-laws which supplement in some detail provincial regulations, but where there is any disagreement the province takes precedence over the municipality. Most by-laws state that the fumigator shall obtain a permit for each fumigation from the medical officer of health. Any deviation from the procedure based on the information on this permit constitutes an infraction.

The Provincial regulations place upon the municipal authorities the obligation to see that the fumigator observes them. Penalties for infractions are severe, as they should be, because it is necessary to avoid accidents, which are usually fatal.

In St. Catharines several years ago, as there was difficulty in making some persons fumigate premises, the Council passed "a by-law to provide for the extermination of vermin". This has helped considerably in cleaning up many infested places, and puts the responsibility for reporting these premises on tenant or owner. This by-law has been a pattern which has been used by several other municipalities.

RESPONSIBILITY OF THE MEDICAL OFFICER OF HEALTH

Because of the increasing number of fumigations, there is much more responsibility to be assumed by the medical officer of health. In the smaller municipalities he supervises the procedure for fumigations; in the larger places he may delegate this authority to one of his inspectors. Many health officers do not assume any responsibility for fumigations, often because of ignorance of the Act and Regulations. This, however, is really no excuse, and if fumigations are improperly done or if a fatality occurs the health officer may find himself in an unenviable position.

Every use of cyanide should be a matter of real concern to the health officer. He should know well in advance the date and time of fumigation, the type and cubic-foot capacity of the building involved, and the number of occupants, as well as the kind and amount of material to be used. He should be interested in knowing if any other portion of the building is occupied, and who is to be employed to assist the operator. Unless he does know all of these things, he is unwise to approve of the fumigation. In our own city the application for fumigation is made out by the licensed operator and, after being approved, copies are made and sent to the police and fire departments. Another copy goes to the sanitary inspector, who fills in the time when fumigation will commence and the time when the placard will be removed. When completed, this form gives a good record of each fumigation.

We supply the operator with a letter to the occupants of premises to be fumigated telling them that they must vacate during fumigation and airing, and the minimum temperature at which the premises should be kept. It tells them what care to take of food, refrigerator, etc. Children should be kept out of the fumigated premises for a day longer than adults. Some of the things advised cannot be insisted on, but at any rate we give the people the necessary precautions to avoid trouble. After all, we cannot expect either the occupants or the general public to know about all the dangers of cyanide fumigation.

While fumigation is in progress, the sanitary inspector from the Department of Health visits the premises to make sure that the placards are in place and that the guard is on duty.

DUTIES OF THE OPERATOR

Every operator should be in good health, well-trained and careful. Before being licensed he must prove to the authorities that he is capable of safely handling cyanide compounds. He must know how to protect himself and others; must be reliable, honest and efficient.

Before every fumigation, it is necessary to inspect carefully all parts of the building in order to decide whether special precautions are necessary to protect life and do an efficient job. Then the official permit is secured from the health officer.

When making financial arrangements with a client, it is well to remember that the labourer is worthy of his hire. I sometimes wonder if fumigations can be done efficiently at some prices advertised. A fumigator should be fair with his clients, and in every case do as good a job as possible. Because of the condition of some buildings, perfect results from all fumigations may not be possible, even when extra materials are used. It is unwise for any fumigator to "guarantee" too much, as in spite of every precaution vermin sometimes reappear.

Before fumigation is started, the fumigator should inspect the premises, and if necessary those adjoining, to make sure that no one is inside. Nor is it wise to overlook pets. The operator is responsible for the locking of all outside doors, and he should retain possession of all the keys.

In Ontario, it is not legal to do "secret" fumigations. The warning cards which must be in place on all premises where cyanide is used are 14" in length, 10" in width, and must have, in red, block letters, the word "DANGER" 2½" high. At night these cards must be illuminated. The cards should be securely tacked on all outside doors, and must be in place before fumigation begins and may be removed only by the operator after the premises are aired and considered safe for reoccupation. As an extra precaution, the placard should cover the keyhole, in order to discourage the use of a spare key. A warning card in the back window will advise members of the Fire Department of danger if they are called to the premises during a fumigation.

A temperature of at least 70°F. is necessary during the fumigation and airing-out, because a lower temperature may cause trouble. As the operator is the only one who may enter the premises during this time, it would seem only reasonable that he should be responsible for making sure that the proper temperature is maintained.

The efficacy of the fumigation depends entirely on how well the operator does his work, on the quality and quantity of the materials, and on the length of time the gas is used. In every case the operator must use his experience and judgment in order that the fumigation may be successful.

The equipment used must be in first-class condition, and the mask must be perfect in its operation. I do not need to remind this audience that you can never make more than one mistake in regard to your masks. It would seem reasonable to suggest that every operator have a well-equipped first-aid kit available at every fumigation, with complete instructions for its use.

The assistant must be carefully instructed in regard to his duties, and should know what to do in case the operator gets into difficulties. The guard, or guards, on the building should be well instructed, and only intelligent adults should be employed. Fatalities have occurred which might have been avoided if the guard had used common sense. All assistants must know exactly what to do in case someone is overcome with cyanide gas, because when this occurs every second of time is valuable. The guard must allow no one except members of the Fire Department to enter the building during its fumigation, and then only after warning them of the danger. The ordinary fireman's mask may not be safe for cyanide gas. In no circumstances should a guard leave his post, and when one house in a row is being fumigated guards should be on duty at both the front and back of the premises.

CONCLUSION

The health officer of every municipality must take a keen interest in every fumigation of premises where cyanide compounds are to be used. It is his responsibility to make sure that the regulations in regard to these are properly carried out so that fumigations may be safely and efficiently done.

If everyone concerned with these fumigations does his work properly and assumes his share of responsibility, accidents from fumigations should never occur.

Population Estimates in Wartime

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DURING wartime the unprecedented interprovincial, inter-urban and rural migration of the people have rendered most difficult the appraisal of the population, especially in urban areas. Whatever method is used in the estimation of population in intercensal or post-censal years, only an approximation can be obtained. If only one system or method is used, one must take into account the wide margin of error probably involved in such a method. If there were in operation a system of continuous registration for each individual which would record every migratory movement from birth throughout life, in respect of every starting- and stopping-place, including that ultimate destination the grave, the statistician could achieve a closer approach to accuracy in population estimates. Such a system of continuous population registration could be found in several European countries, e.g. Sweden and the Netherlands. There is not such a system in Montreal and the vital statistician had one of the most trying problems to solve in computing the population for the metropolis of Canada for the years 1940 and 1942. The Dominion Census provided the population figures for 1931 and 1941, but we all know that the degree of inaccuracy of population estimates tends to increase with the time elapsed since the last Census, so that any estimates of the 1940 population based on the 1931 Census might show a serious error, while the 1942 estimate should come very close to the actual population.

Table I shows a comparison between the figures of the Dominion Census and those of the Health Department.

TABLE I
COMPARISON BETWEEN THE FIGURES OF THE DOMINION CENSUS
AND THOSE OF THE HEALTH DEPARTMENT OF MONTREAL

Year	Estimation based on Dominion Census	Health Department estimates	Percentage difference
1940	894,600 (1)	907,000	1.76
1941	903,007 (2)	907,000(4)	0.44
1942	? (3)	926,000	....

(1) Figures obtained by interpolation between the Censuses of 1931 and 1941.

(2) Dominion Census figures.

(3) This figure will be known by interpolation following the 1951 Census.

(4) Estimate used until the Census figure became known.

Before analysing the many sources of contemporary data and the methods of computing them that led to these approximations, let us outline the changes in the population of Montreal due to the second World War. Similar conditions prevail in metropolitan areas all over this continent.

(1) The establishment of new war industries and the constant develop-

ment of the existing ones within the city and its suburbs resulted in a striking increase of immigration from the rural areas to the city.

(2) A number of refugees of different races—English, French, Jewish—entered the country and settled in Montreal.

(3) Members of the armed forces, often accompanied by their families, were stationed permanently in the city.

(4) Finally, the growth of the transportation systems and the acute shortage of suitable houses showed that there had been a notable increase in the urban population since September 1939.

These factors were, however, partially offset by (1) a gradual migration of citizens towards small neighbouring cities, though this trend has slowed down due to war restrictions; (2) the permanent establishment of labourers (Montreal residents) in the neighbourhood of the war industries located outside Montreal; and (3) a constant increase in the number of volunteers and draftees leaving Montreal for training centres.*

As was observed elsewhere, this metropolis saw an increase in the number of hasty marriages, as well as a sharp rise in the crude number of births due to the improved economic status and the fertility of these young couples.

METHODS OF COMPUTING POPULATION ESTIMATES

1. The Natural-Increase Method for Estimating Population

If we watch the growth of an urban agglomeration of the size of Montreal, we notice that every population's progress is related not only to natural increase but also to a migration factor. Compulsory declaration of births and deaths allows us to determine the natural increase of a population and to follow its evolution from year to year. This can be done with accuracy if there is proof that 100 per cent of births and deaths are registered.

Figure I shows the evolution of the natural increase of Montreal's population from 1911 to 1942.

Aside from the years during the first World War and the epidemic of influenza, the natural increase, which represents the excess of births over deaths, remained high from 1911 to 1931. From 1931 to 1941 the natural increase touched its lowest level since 1885 (when the number of deaths exceeded the total births following an epidemic of smallpox). This is due to the fact that the birth rate exhibited a marked downward trend while the death rate, after decreasing during the first two years of the decade, was brought to a standstill and even increased slightly in 1940. In 1941 and 1942, the natural increase shifted back to an upward trend; this was due mainly to the increase in the number of births, as the deaths did not reveal a striking increase.

To the natural increase we must add an excess of immigration over emigration or deduct an excess of emigration over immigration, as the case may be. In these eventful times, the complete collection of these data offers the most difficulties.

*The City of Montreal is not considered a military training centre.

Table II shows the foreign immigration in the Province of Quebec and the City of Montreal from 1911 to 1940, by decades:

TABLE II
FOREIGN IMMIGRATION IN THE PROVINCE OF QUEBEC AND
THE CITY OF MONTREAL, 1911-1940

Decade	Immigration in the Province of Quebec	Immigration in Montreal (1)	Percentage (2)
1911-20	317,885	40,447	26.87
1921-30	169,260	58,160	29.07
1931-40	32,480	13,410 (3)	15.88

(1) Figures drawn from table 26, Vol. IV, Federal Census, 1931.

(2) Percentage that represents the proportion of immigration in Montreal compared with the total increase of the population.

(3) Official figure published by the Dominion Bureau of Statistics in Bulletin A-7, minus 1941 estimated figures.

A large number of the new arrivals did not settle in Quebec but merely passed through the province on their way to Ontario and the Western Provinces.

It will be seen from the table that up to 1930 there was an increase in the number of immigrants in Montreal, in opposition to the general trend of immigration in the province. In fact, the number of immigrants increased by one-third in Montreal from 1921 to 1930, while in the province it showed roughly a 50 per cent decrease in comparison with the preceding decade.

From 18,405 in 1930, the number of foreigners entering the province fell to 1,931 in 1941. The decline can be attributed in a large measure to the strict

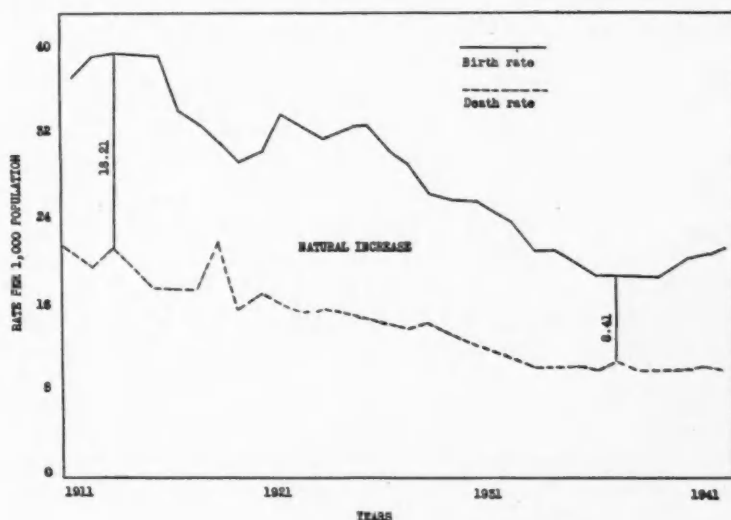


FIGURE I
BIRTH RATE AND DEATH RATE PER 1,000 POPULATION
MONTREAL, 1911-1941

regulations which were adopted by the Dominion Government and which are still enforced.

The population of Montreal has not been increased by annexation. Since 1918 there have been no annexations, with the exception of a fraction of the St. Laurent Parish which was added in 1932. Though the area covered ninety-nine acres, the population was too small to make any marked difference.

To summarize, this method cannot be used to compute an accurate estimate, due to incomplete data on local outward and inward movements of the population. However, the natural-increase method can be used as a guide to check the results of the other methods.

2. *The Geometrical and Arithmetical Increase Method for Computing Population*

"Conditions change from one decade to another to such a degree that it is incorrect to compute an annual population with the geometrical-increase method based upon the rhythm of prior decades."*

On account of heavy local migration due to the shifting of men to military camps and labourers to war industries, these remarks are even more applicable to conditions in the years 1940 and 1942.

One can also apply this quotation to the figures calculated with the arithmetical-increase method based upon the difference of the population between the two preceding Censuses.

Table III shows the populations which one obtains for the years 1891 to 1941 from the arithmetical and geometrical increase compared with the population enumerated by the Dominion Census.

TABLE III
POPULATION OF MONTREAL AS COMPUTED BY THE ARITHMETICAL AND GEOMETRICAL INCREASE AND AS ENUMERATED BY THE DOMINION BUREAU OF STATISTICS

Year	Dominion Census population	Population according to the	
		Arithmetical-increase method	Geometrical-increase method
1891	216,650	.....	.....
1901	267,730	.....	.....
1911	467,986	318,810	456,012
1921	618,506	668,242	642,786
1931	818,577	769,026	750,726
1941	903,007	1,018,648	950,927
1951	.....	987,437	1,013,327

From this table it can be seen that at each decade the Census figures differ from the estimates based upon the arithmetical and geometrical progression. For these reasons, this paper does not advise the use of the arithmetical and geometrical increase method for computing our population. This opinion is in agreement with that of Henry S. Shryock Jr., of Princeton University.

*From the foreword of a documentary analysis of the population increases of Montreal by Valmore Gratton and Geo. S. Mooney, co-directors of the Montreal Industrial Bureau, published in 1940.

3. Method for Estimating the Population from the Local Directory

Table IV shows the population of Montreal and its suburbs for the year 1941 according to the City Directory's estimate and the Census figures.

TABLE IV
POPULATION OF MONTREAL AND ITS SUBURBS* FOR THE YEAR 1941 ACCORDING TO THE
DIRECTORY'S ESTIMATE AND THE CENSUS FIGURES

	Directory's estimate*	Dominion Census	Difference	Percentage difference†
Montreal.....	1,307,592	903,007	+ 404,585	44.8%
Other municipalities.....	185,600	187,101	- 1,501	0.8%
Greater Montreal.....	1,493,192	1,090,108	+ 403,084	

*The Directory includes within Greater Montreal: Longueuil, St. Lambert, Montreal South, Montreal East, Montreal West, Lachine, Ville LaSalle, Ville St. Pierre, Hampstead, Mount Royal, St. Laurent, Outremont, Verdun and Westmount.

†This percentage difference is based on the assumption that the figures published by the Dominion Bureau of Statistics are accurate.

How can one explain the fact that the Directory's estimate for the City of Montreal is higher by 400,000 than the Dominion Census figure when its estimate of the suburbs surrounding Montreal falls short by 1,500 in comparison with the figure enumerated by the Dominion Census? (The percentage difference is 44.8 and 0.8, respectively.)

Obviously these two results are not consistent. The publishers of the Directory agree that their estimate is too high, as many individuals may be listed both at their residence and their business address. For this reason, we do not advise the use of this method for estimating the population of Montreal.

4. Method for Computing the Population according to the Index of Occupied Dwellings

This method is founded upon the hypothesis that "the number of occupied dwellings is in proportion to the size of an urban population". This hypothesis cannot always be put to a practical use, however. For instance, during depression years, or when there is a shortage of dwellings, people live in smaller homes or two families live together in the same household. When there is an adequate number of dwellings, or when prosperity returns, each family moves to its own home. If other factors are added, such as an abnormal increase in the number of marriages, a heavy immigration from rural areas, etc., a serious need for dwellings may result. Young married people must live with their in-laws, lodgers must board with private families. Thus there is an increase in the population while the number of dwellings remains the same.

On the other hand, the tendency is to build small units of housing, as in apartment houses. This does not necessarily mean an increase in the population. The small number of rooms in these apartments increases the difficulties of large families in finding suitable quarters.

Since 1939, Montreal has recorded a notable rise in the number of marriages and births; a slight increase in the number of newly built dwellings, especially in the prosperous wards; and an overcrowding of households, due partly to the increase in the number of lodgers and young married couples.

We have reason to believe that these different factors are corrected and adjusted by each other and that the index of occupied dwellings—that is, the result obtained by dividing the population enumerated in the Census (less the population of institutions) by the number of occupied dwellings as published by the Assessors' Bureau—can be used to estimate the population of Montreal.

Let us examine in table V the population figures obtained by the use of different indices.

TABLE V
ESTIMATES OF THE POPULATION OF MONTREAL FOR 1941-1942 ACCORDING TO THE
FEDERAL AND MUNICIPAL INDICES PER DWELLING

Year	Total number of dwellings	Number of vacant dwellings	Number of occupied dwellings	Pop. based upon the federal index per occupied dwelling—4.40 (1)	Pop. based upon the municipal index per occupied dwelling—4.31 (2)	Arithmetical mean
				No. of occupied dwellings $\times 4.40 + 40,000$	No. of occupied dwellings $\times 4.30943 + 40,000$	
1941	201,897	1,637	200,260	921,144	903,007	912,076
1942	204,091	671	203,420	935,048	916,624	925,836 (3)

(1) Official figures published by the Dominion Bureau of Statistics in Bulletin No. 28.

(2) Index resulting from the division of the population enumerated in 1941, after subtracting 40,000 (the population of the institutions), by the number of occupied dwellings, issued by the municipal Assessors in 1941.

(3) To this figure one must add a few thousand people who lodge in stores and haphazard shelters.

5. Method of Estimating the Population with the Rationing Commission Data

The 1942 Rationing Commission data, notwithstanding their shortcomings, could be used as a check for estimating the floating population which may be in a city on any one day.

If we analyse this problem from every angle, we should define the terms "floating population" and "permanent population". In my opinion, a permanent population, as defined by the "de jure" principle, includes only those who have had their permanent place of abode in the city for a period of one year. The floating population, according to the "de facto" principle, may be subdivided into a temporarily resident population and a transient population. The former occupies a residence for several months, as for example students who attend universities and boarding-schools during eight or nine months and service personnel stationed in depots for a period of six weeks to six months. The transient population includes travellers, tourists, salesmen and service personnel on furlough.

While the Rationing Commission data probably account for a large number of

the residents and the temporarily resident, they do not include all of the transient population. However, we have reason to believe that the loss of this population is offset by the large number of people who, while residing in suburbs of Montreal, have obtained their ration books at their place of business within the limits of Montreal.

Therefore, the Rationing Commission data seem to offer, with certain reservations, the most accurate information for estimating the floating population of a large city—in this instance Montreal. The crude number of persons who obtained a ration book in the city of Montreal in 1942 was 983,929, while the corrected number was 1,001,000.

6. *Method for Estimating the Population according to the
Catholic Parishes' Annual Census*

In general, the parochial census is well enumerated by the clergy, as is shown by the fact that in 1931 a difference of 4,274, or only 0.82 per cent, was found between the figure of the French-Canadian Catholic population as enumerated by the Dominion Bureau of Statistics and that counted by the clergymen.

Every year, the parish priests count their Catholic population when they visit the home of each parishioner. The total Catholic parishes within the limits of Montreal is 108, of which 77 are French-Canadian and the rest other nationalities. Because of the extent of their territory and the dispersion of their population, we cannot include the figures for the parishes of other nationalities. A few French-Canadian parishes which are located in the suburbs and overlap the city limits are not included in the total of 77. The loss of these groups is offset by the inclusion of Montreal parishes which extend into municipalities surrounding Montreal.

Of recent years the French-Canadian Catholics of Montreal have represented over 64 per cent of the total population. Any population changes of importance that would occur in the city cannot pass unnoticed in that important sample. The predominance of the French-Canadian Catholic population in Montreal is shown in table VI. While we realize that the estimate computed by this method probably falls short of the true population by about 1 per cent, and should be corrected, we believe that we may safely recommend its use in this instance because this annual census covers such a large proportion of the population and over a period of years these shortcomings remain practically the same.

7. *Method for Estimating the Population Based upon the Enrolment
of Elementary-school Children, according to the
Method Outlined by Henry Shryock*

"This method is a very elaborate and time-consuming procedure. Essentially, however, the method falls in two parts. The difference between registered births and deaths, both corrected for under-registration, is considered as the postcensal natural increase and is added to the city's population at the last

census. The net inward and outward migration of school children is estimated from the city's actual and expected school enrolment. The migratory gain or loss in this group is prorated to persons of all ages. The final net change due to migration is then added to the calculated natural increase and the census population to get the postcensal estimate."

School statistics might be improved by obtaining actual enrolment by age in all schools, private as well as public, reallocated to the actual residence of the child.

TABLE VI
COMPARISON BETWEEN THE POPULATION ENUMERATED AND INTERPOLATED BY THE DOMINION BUREAU OF STATISTICS AND THE POPULATION ENUMERATED BY THE FRENCH-CANADIAN CATHOLIC CLERGY—1931, 1940 TO 1942—MONTREAL

Year	Population according to the Dominion Bureau of Statistics	Population enumerated by the French-Canadian Catholic Clergy
1931	818,577 (1)	514,491 (518,745) (1)
1940	894,600 (2)	576,267
1941	903,007 (1)	580,058 (3)
1942	920,227 (4)	591,117

- (1) Figures of the Dominion Census.
- (2) The population of 1940 results from interpolation based upon the Dominion Census figure of 1941.
- (3) The correct number of French-Canadian Catholics at the last federal Census is still unknown.
- (4) As the exact number of the French-Canadian Catholic population has not been published by the Dominion Bureau of Statistics, it is impossible for us to calculate its percentage of the whole population of Montreal as enumerated in 1941. We must take the percentage that is represented by the population counted by the clergy from 903,007 (Ottawa's official population of Montreal): that is, 64.236 per cent. If we admit that this percentage has not changed since last year, and we apply it to the population enumerated by the clergy in 1942 (591,117), we get the following result:

$$\frac{591,117 \times 100}{64.236} = 920,227.$$

These valuable data would inform us about the migratory movements of only a minority of the population. Corresponding movements of persons in other age groups, especially adults without young children, would remain highly speculative. Though we recommend this method, we were unable to use it this year due to incomplete data from private schools.

Table VII summarizes the results obtained from several methods of computing population estimates of urban areas from local data, excluding those we do not recommend.

It is evident that we do not include the military personnel, apart from those entitled to a subsistence allowance with permanent quarters. We also added estimates based upon data computed by two important public services but derived from different sources, federal and private.

CONCLUSIONS

During wartime the unprecedented interprovincial, inter-urban and rural migration of the people have rendered most difficult the appraisal of the popula-

TABLE VII
COMPARISON OF THE POPULATION OF MONTREAL CALCULATED ACCORDING TO SIX DIFFERENT METHODS
FOR THE YEARS 1931, 1941, AND 1942

Year	"De facto" Population (1)		Year	"De jure" Population (2)					Total enumerated and estimated populations	Arithmetical mean	
	Enumerated			Enumerated	Estimated			with the occupied-dwelling index			
	by the Rationing Commission Board				based upon the French-Can. Catholic Parishes census	by the Bell Telephone Company	according to the number of dwelling issued by the Post Office				according to the number of dwelling issued by the Assessors' Bureau
	Crude figure	Corrected figure									
1931	.....	.....	1931	818,577	813,000	829,000	.....	818,577	3,279,154	819,788
1941	.....	.....	1941	93,007	907,000	913,800	.....	912,076	3,635,883	908,970
1942	983,929	1,001,000	1942	.....	920,227	925,442	930,718	925,836	3,702,223	925,556

(1) This population includes the resident population plus the floating population.

(2) This population includes only the resident population.

FINAL ESTIMATE OF THE POPULATION RESIDING PERMANENTLY IN MONTREAL, JULY 1, 1942: 926,000.

FINAL ESTIMATE OF THE RESIDENT POPULATION PLUS THE FLOATING POPULATION IN MONTREAL, JULY 1, 1942: 1,001,000.

tions of cities. As the public-health work of large communities must be guided by birth, death and morbidity rates, we must strive for a high degree of accuracy in estimating the populations upon which they are based.

Besides a system of continuous registration, more frequent federal or municipal censuses, supplemented by an annual sample enumeration undertaken locally, would solve this problem. In my opinion, the mean of different estimates of the population of Montreal based upon local data such as the enrolment of elementary-school children, the index of occupied dwellings (enumerated every year by the municipal assessors), the parochial census taken every year, and the Dominion Census, probably is very accurate. The average error of combined estimates may be lower than the error of any of the original data, taken separately. This end can be obtained only when the original methods are unrelated and their errors not too far apart.

Other cities could test their local material much more exhaustively before encouraging interested parties to adopt the measures quoted above in order to obtain accurate population figures essential to the proper functioning of public health and to the planning of the future welfare of large communities.

BIBLIOGRAPHY

1. Archives, Archbishop's Palace, Montreal, Annual Census Reports, 1931-1942.
2. Department of Public Health, Montreal, Annual Reports, 1911-1941.
3. Dominion Census Volumes, 1911-1931; Bulletins, 1941.
4. Dominion Post Office, Montreal, Annual Report, 1942.
5. Gratton, V., and Mooney, G. S., "Etude documentaire sur l'accroissement de la population de Montréal, 1940.
6. Hulse, A. E., Annual Reports of the Assessor's Department of the City of Montreal, 1941, 1942.
7. King, H., Ration Book No. 1, March, 1943.
8. Lovell, W., Directory of Montreal, 1941.
9. O'Brien, W. T., Bell Telephone Co., 1931-1942.
10. Pearl, R., Medical Biometry and Statistics, W. B. Saunders Co., Philadelphia, 1940.
11. Shryock, H. S., Jr., Am. J. Pub. Health, 1938, 28: 1042.
12. Statistical Year Book, Province of Quebec, 1931-1941.
13. Whipple, G. C., Vital Statistics, John Wiley & Sons, Inc., New York, 1923.

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POLIOMYELITIS

WE meet the polio' season again this year with little if any clearer understanding of its mode of spread than we had twenty years ago. We have learned much, it is true, in the two decades, but we have not learned the actual means of spread or how to prevent it. The virus has been recovered from the faeces and from the throat of both cases and non-cases; it has been recovered from sewage and from flies, but no hypothesis of a single manner of spread based on any of these findings completely fits all cases. We have learned that diagnosis in the absence of paralysis is, to say the least, very uncertain; that the use of convalescent serum in the so-called preparalytic stage is without value and that chemical nasal applications are not only without value but are attended with definite risks. The wide publicity given, with what we thought was proper purpose, to what we thought we knew of the prevention of paralysis, has created a highly sensitive polio' consciousness on the part of the public and, too, of the profession. It created undue apprehension regarding poliomyelitis and an unwarranted faith in our ability to meet the problem. Very real as the problem is and regrettable and unfortunate as is paralysis, it should be remembered that the actual risk, the chance of paralysis in a population even during an epidemic, is small—small, indeed, compared with other risks of young life: diarrhoea and dysentery, accidents, respiratory infections, etc. This is not to imply that complacency is to be condoned, but excitement and fear add to the problem rather than alleviate it in any way and neither should be encouraged. We must admit humbly and frankly our mistakes and our ignorance, and our inability to control the spread. Such control measures as may be applied should be based on sound principles, adapted to the local situation. The very human failing of responding to the urge to do something should be restrained and only such action taken as is compatible with common sense, general knowledge and our meagre knowledge of the specific disease. Ill-balanced enthusiasm and excitement coupled with well-meaning but misconceived action beget only confusion. The physician seeing the case should remember that the patient is primarily his responsibility and that he can apply basic principles in treatment as well as anyone else. He is not helpless. Diagnosis even of the suspect case may require repeated visits and investi-

gation and such diagnosis is the function of the physician. Help should be available when requested or required but it must be remembered that neither the public health official nor the clinical consultant is supernaturally endowed with knowledge that is not yet available. The practice of sending suspect cases to hospital indiscriminately is to be deprecated.

The physician in the rural community has the opportunity as no one else has, through careful observation, accurate record and painstaking correlation with attendant circumstances, to learn more and establish more of the natural history of the disease. It is to him that public health must look for essential assistance in the further elucidation of this problem, as of others. He has the opportunity and the capacity to teach us much if he is allowed to do so.

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ONTARIO HEALTH OFFICERS ASSOCIATION

Letters to the Editor

CHEESE AND TYPHOID FEVER

SIR:

I have read with interest the editorial in the May number of the *CANADIAN JOURNAL OF PUBLIC HEALTH* entitled "Cheese and Typhoid Fever".

For a number of years those of us working in cheese research here at Geneva and also at Ithaca have realized that there are certain definite dangers of transmitting pathogenic organisms through the eating of cheese. The first paper that we published in this field is the one by Dr. Hucker and Mr. Marquardt (Proc. N.Y. State Dairy and Milk Inspectors Assoc., 10th Ann. Rep., 1936, 171-203), in which they studied the possibility that septic-sore-throat streptococci might be active in cheese. Later this work was carried further by our Dr. Yale and Mr. Marquardt. At the time that Dr. C. D. Kelly, now at McGill University, was doing our cheese research work, he wrote a circular discussing the pasteurization of milk for cheese-making (N.Y. State Exp. Station Circ. 175, 1937).

As the years have passed, we have followed reports of staphylococcic food poisoning in high-moisture types of cheddar cheese, and also reports of the survival of *Brucella* organisms in cheese. In fact, the Research Committee of the National Cheese Institute, which is composed of manufacturers and distributors of cheese, have given funds to institutions here in New York State for the study of the survival of *Brucella* organisms in cheese. This study has been carried out co-operatively by Dr. A. C. Dahlberg and Dr. H. L. Gilman of the University faculty at Ithaca. They have carried on this work for several years and their data are nearly ready for publication. (See 62nd Ann. Rep., N.Y. State Exp. Station, 1943, p. 23.)

Meanwhile, when I visited Mexico two years ago, I became aware of the fact that Mexican public-health men were conscious of the presence of a certain amount of Malta fever in Mexico. Dr. Huddleson of Michigan, after visits to Mexico, confirmed the prevalent thought that much of this Malta fever came from the eating of goat-milk cheese made from raw milk.

Recently the Federal Food and Drug Administration office at Denver, Colorado, has been studying an outbreak of undulant (probably Malta) fever among Americans of Mexican descent in southern Colorado, and has found no difficulty in isolating undulant-fever organisms from goat-milk cheese. A news release from the California State Department of Agriculture that has reached me this week tells of a typhoid outbreak from eating high moisture-content cheese of special types that are made in California.

Fortunately there is good information to show that cheddar cheese of very satisfactory quality can be made from pasteurized milk. In fact, New Zealand cheese has been made from pasteurized milk for many years and is generally regarded as having a uniform high quality when it reaches the London market. Several studies on the manufacture of cheddar and limburger cheeses from pasteurized milk have been made here, at Ithaca and at Madison, Wisconsin, in recent years, and work is still in progress in this field at Ithaca under the supervision of Dr. A. C. Dahlberg.

I am writing this to assure you that agricultural workers are and have been giving serious consideration to this problem. We are hopeful that the phosphate test may be applied satisfactorily to cheese so that public-health workers will have a means of checking the method of manufacture used. The Dairy Products Committee of the American Public Health Association, at its last

meeting about a month ago, tentatively approved the publication of a manuscript presented to it by Dr. Yale, now of Green Bay, Wisconsin, Dr. Dolman of Vancouver, Canada, and Dr. Gilman of Ithaca, outlining methods for isolating various types of pathogenic bacteria that may be present in cheese.

The attitude of the manufacturers and distributors of cheese has been most co-operative in regard to these problems. In fact, one of the larger makers reports that all cheddar cheese made in factories owned and operated by them is already made from pasteurized milk and other manufacturers are making progress in the same direction.

ROBERT S. BREED, Ph.D.

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SIR:

We have noted your editorial on pages 204-205 of the May issue of the CANADIAN JOURNAL OF PUBLIC HEALTH on "Cheese and Typhoid Fever".

You may be interested in knowing that we recently had an outbreak of typhoid fever traced to unpasteurized, uncured cheese. As a result thereof, legislation was enacted in this State requiring either pasteurization of milk going into cheese or a curing period for unripened cheese.

A copy of the legislation as adopted and now in effect is enclosed.

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CALIFORNIA STATE DEPARTMENT OF PUBLIC HEALTH

June 16, 1944.

TO ALL HEALTH OFFICERS:

You are advised to watch for the June 15th issue of "California's Health" in which will appear a report of the recent typhoid-fever outbreak which was due to unpasteurized, uncured cheese.

Since that article went to press, the Fifty-fifth (Fourth Extraordinary) Session of the Legislature has amended the Agricultural Code as follows:

ASSEMBLY BILL No. 45

"An act to add Section 540 and to amend Section 547 of the Agricultural Code relating to cheese, declaring the urgency of this act, to take affect immediately".

SECTION 1. Section 540 is added to Article 6, Chapter 2, Division 4 of the Agricultural Code, to read:

540. All cheese sold in California to the retail trade shall be pasteurized or manufactured from cream, milk, or skim milk which has been pasteurized, except cheese which has been allowed to ripen or cure for a minimum period of 60 days from date of manufacture.

SEC. 2. Section 547 of the Agricultural Code is amended to read:

547. All cheese sold in California, except that defined in Section 542, must be

labeled at the factory where manufactured to indicate the variety, and if of different grades, the grade, whether whole milk, part skim, or skim, the factory number, State of origin, and date upon which the cheese was manufactured. *Cheese manufactured in any State where factory numbers are not assigned shall be labeled with the name and address of the plant where manufactured.* It is unlawful to expose for sale any part-skim cheese, or skim cheese unless there is attached to the outside of every vessel, can, package, cheese, or piece of cheese so exposed or sold, a tag legibly bearing in black letters at least one inch in height the words "part-skim cheese" or "skim cheese" as the case may be. All part-skim or skim cheddar or granular cheese shall be labeled to indicate the grade on its entire outer edge in a manner specified in the rules and regulations promulgated by the director and all such cheese shall be made in the shape and size specified by the director.

All other varieties of part-skim or skim cheese shall be labeled to indicate the grade in such a manner as is outlined in the rules and regulations promulgated by the director. The provisions of Section 470 of this code shall not apply to cheese manufactured or processed in foreign countries.

SEC. 3. This act is hereby declared to be an urgency measure necessary for the immediate preservation of the public peace, health and safety, within the meaning of Section 1 of Article IV of the Constitution of the State of California, and as such shall take effect immediately. The following is a statement of the facts constituting such necessity:

Cheese, unless pasteurized or cured for a minimum specified period, is capable of retaining and transmitting pathogenic organisms. In order to prevent communicable diseases from such a source, rectifying legislation is necessary immediately to require for all varieties of cheese either pasteurization or a specified curing period and a system of labeling to insure identity of the product involved.

This bill has been signed by Governor Warren and this amendment becomes effective immediately.

CONFERENCE OF THE VITAL STATISTICS SECTION CANADIAN PUBLIC HEALTH ASSOCIATION

OTTAWA, SEPTEMBER 25, 1944

THE annual conference of the Association's Vital Statistics Section will be held in the Chateau Laurier, Ottawa, on Monday, September 25th, at two p.m. This precedes the sessions of the Dominion-Provincial Conference on Vital Statistics, which will be held on Tuesday, Wednesday and Thursday, September 26th, 27th and 28th. The fall meeting of the Dominion Council of Health will be held on Wednesday, Thursday and Friday of the same week.

Since its organization in 1928, the Vital Statistics Section has afforded assistance and leadership in the public-health aspects of vital statistics and served as a link between the medical profession, public-health officers and government authorities. At this year's session, a number of nationally representative committees will submit reports and, in addition, three papers will be presented: "Health and Welfare—Two Departments or One?" by Dr. G. F. Davidson, Executive Director of the Canadian Welfare Council, Ottawa; "The Need for Morbidity Record", by Dr. N. E. McKinnon, of the School of Hygiene, University of Toronto; and "Canadian Vital Statistics during the War Years", by Dr. Enid Charles, Census Research Specialist, Dominion Bureau of Statistics.

Members of the Association, and others interested, are cordially invited to attend the session.



NATIONAL IMMUNIZATION WEEK

SEPTEMBER 10-16

National Immunization Week, sponsored by the Health League of Canada and health departments throughout the country, again brings to the attention of parents the needless loss of life due to such preventable diseases as whooping cough, diphtheria, smallpox, and scarlet fever. It is not suggested that immunization should be undertaken in this particular week only; the campaign is an effort to warn parents of their responsibility in having their children protected by the simple measures which science has provided.

Further information concerning National Immunization Week can be obtained by writing to the Health League of Canada, 111 Avenue Road, Toronto 5. Copies of an attractive poster, leaflets, and cards for physicians' offices are available for distribution.

